DOCUMENT RESUME

ED 157 015 CS 004 221

AUTHOR	Mason, Jana M.; And Others
TITLE	Effects of Polysemous Words on Sentence Comprehension. Technical Report No. 85.
INSTITUTION	Bolt, Beranek and Newman, Inc., Cambridge, Mass.; Illinois Univ., Urbana. Center for the Study of Reading.
SPONS AGENCY	National Inst. of Education (DHEW), Washington, D.C.
PUB DATE	Ma[illegible] 78
CONTRACT	4[illegible]-76-0116
NOTE	34p.
EDRS PRICE	MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS	*Context Clues; Elementary Education; Failure Factors; *Reading Comprehension; *Reading Processes; *Reading Research; Recall (Psychological); *Semantics; Sentences
IDENTIFIERS	*Center for the Study of Reading (Illinois); *Polysemous Words

ABSTRACT

The effect on comprehension of words containing more than one meaning was studied. In experiment one, subjects in grades four, five, and six were assessed on their ability to recall polysemous words and identify their meanings after having read them in sentence contexts. When words were assigned their primary sense in the sentences, subjects remembered them and their meanings better than when they had been used in a secondary sense. There were reading ability effects but no grade differences. Experiments two and three confirmed the inability of third and fourth grade children to use context to identify secondary meanings of words. Experiment three showed, in addition, that children cannot assess accurately whether they have chosen a correct meaning for a word. The three experiments indicate that children in elementary school frequently misremember the context when a secondary meaning of the word is referenced in a sentence and also fail to choose correct secondary meanings. It is apparent that the presence of polysemous words in text materials is one source of comprehension difficulty. (Author)

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CENTER FOR THE STUDY OF READING

Technical Report No. 85

EFFECTS OF POLYSEMOUS WORDS ON SENTENCE COMPREHENSION

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The research reported herein was supported in part by the National Institute of Education under Contract No. US-NIE-C-400-76-0116. The authors wish to thank the Halifax, Nova Scotia and Tolono, Illinois children and school personnel for their cooperation and Steve Antos for his help in analyzing the data.

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Abstract

The effect on comprehension of words containing more than one meaning was studied. In Experiment 1 subjects in grades 4, 5, and 6 were assessed on their ability to recall polysemous words and identify their meanings after having read them in sentence contexts. When words were assigned their primary sense in the sentences, subjects remembered them and their meanings better than when they had been used in a secondary sense. There were reading ability effects but no grade differences. Experiments 2 and 3 confirmed the inability of third and fourth grade children to use context to identify secondary meanings of words. Experiment 3 showed, in addition, that children cannot assess accurately whether they have chosen a correct meaning for a word. The three experiments indicate that children in elementary school frequently misremember the context when a secondary meaning of the word is referenced in a sentence and also fail to choose correct secondary meanings. It is apparent that the presence of polysemous words in text materials is one source of comprehension difficulty.

Effects of Polysemous Words on Sentence Comprehension

Although vocabulary is a stable indicator of reading comprehension ability (about .79, according to Goodenough, 1925), its role is not well understood. It is posited by Golinkoff (1976), to be one of three sources of comprehension failure and is a principal factor in reading comprehension (Davis, 1944; Russell, 1946; Artley, 1948). A difficulty in understanding the role that vocabulary plays in reading is that we actually have several vocabularies; our speaking and reading vocabularies overlap but are not identical (Miller, 1951). One effect is that printed words and meanings may not be well integrated until appreciable reading skills have been obtained. One approach to studying vocabulary use and understanding is to measure children's ability to recognize the need for secondary meanings of words. The rationale is that, unlike most reading tasks, decisions about ambiguous words can be studied by varying the surrounding context. Only with disambiguating context, for example, can a reader know what meaning to ascribe to the word beam, such as the sentence, The beam was burned in the fire.

Adults realize that many words are polysemous, that without context words can be characterized by more than one meaning, and that only through context is a particular meaning obtainable (Anderson & Ortony, 1975). As a result, adults do recall less common senses of a word. Mackay (1966) and Foss (1970) found that sentences which contain words that cannot be disambiguated immediately take longer to read. Cairns and Kamerman (1975) showed that both meanings of ambiguous (or polysemous)

words are usually retrieved but, following sufficient contextual support, only one is remembered. Hogaboam and Perfetti (1975) found that, when presented with sentences in which the last word has a multiple meaning, adult subjects appear to access a primary meaning before a secondary meaning. This suggests that a secondary meaning is accessed only when a primary sense is not supported by context.

Very little work of this nature has been completed with children who are still unskilled readers. In a nonreading task, Kessel (1970) found that even kindergarten children realize that orally presented sentences can be interpreted in more than one way. Thus it appears that children have acquired multiple senses of some word meanings. It has not been demonstrated, however, whether the same flexibility is available during reading.

The purpose of the study was to determine whether children in middle and upper elementary grades interpret and remember information in sentences when that information contains words whose meanings are substantially affected by the context of the sentences. If children can identify, use, or remember primary meanings of words but not their secondary meanings, this would imply that, unlike adults, children do not or cannot use contextual cues to disambiguate meanings of words.

Experiment 1

Method

Materials. Ninety-six polysemous words which had been used in a secondary sense in the Ginn & Company (Ginn 360) reading textbooks,

grades 4-6, were listed. Thirty college students defined these words by writing the first meaningful associate that they thought of for each word. This norming served as a basis for selection of 20 words, with a mean frequency of 128 per million (Carroll et al., 1971). Each word contained a strong primary and weak secondary sense. College students' responses also guided the selection of primary and secondary meanings and terms. For example, for the word rent, most of the students wrote pay for or lease; a few students, however, gave the less common meaning of tore or ripped.

Two sentences, one supporting the primary meaning and one supporting the secondary, were created for each word. Also, four multiple choice responses were selected, one supporting the primary sense, one a secondary sense, and one the sense of each sentence but not the word. For example, for the word crack, the two sentences were, "There was a huge crack in the floor" and "George made a crack about his sister's new dress." Multiple choice items were joke, nail, song, and split.

Text materials were arranged in an A-B, B-A Latin square format so that half of the sentences each child read used the words in a primary sense and half used a secondary sense. Altogether, then, each word was tested in both its primary and secondary sense.

Subjects. Seven intact classrooms were tested--two each from grades 4 and 5 and three from grade 6. The children attended public elementary schools in Halifax, Nova Scotia and lived in middle income residental neighborhoods.

Assessments of reading ability were obtained for each child from two sources: teacher rankings of their students using a 3-point scale and

school administered comprehension and vocabulary tests.

Procedure. All subjects completed four tasks, each task appearing on a separate page. They were not permitted to look back. The task order was: (1) write a meaning for each of the 20 words; (2) read 20 unrelated sentences, each of which contained one of the polysemous words with instructions to make an imaginary picture of each sentence so as to be prepared to answer questions; (3) write short answers to questions that reference each target word; and (4) select from four choices the meaning of each target word used in the 20 sentences.

For example, for the word bored, half of the children saw the sentence, "The speech bored the audience;" the other half saw, "Father bored a hole in the wall." Next they wrote the answer either to, "What did the speech do to the audience?" or to, "What did Father do to the wall?" Lastly, both groups saw, "bored: (a) drilled (b) filled (c) tired (d) excited," and then circled the meaning that had been used in the earlier sentence. In scoring the cued recall (third) task, responses of the target word or a paraphrase of the target word were counted correct.

Results

Responses to the first task, which indicated agreement between children and adults about primary and secondary senses of the words, were not used in subsequent analyses. An analysis of variance was used to measure the effects of the last two tasks. Obtaining no effect of the Latin square ordering, the dependent variables, cued recall and recognition, were analyzed using grade (4, 5, and 6), and reading ability (higher, middle, lower, based on teacher assessment), and word meaning (primary or secondary).

Mean scores are listed in Table 1. There were significant main effects of ability, $F(2,167) = 37.1$, $p < .001$; task, $F(1,167) = 24.4$, $p < .001$; and meaning, $F(1,167) = 325.7$, $p < .001$. There were significant interactions between ability and meaning, $F(2,167) = 15.5$, $p < .001$; task and meaning, $F(1,167) = 246.5$, $p < .001$; and grade and ability and task, $F(4,167) = 3.5$, $p < .01$.

Insert Table 1 about here

The task by meaning interaction indicated that secondary meanings were very poorly identified in the recognition task (see Table 1). The ability by meaning interaction showed that there was a much greater difference between primary and secondary meanings for lower ability readers than for middle or high ability readers (Figure 1). The 3-way interaction showed that the differences between the ability by task interaction was somewhat greater at fourth and fifth grade than at sixth grade, and that lower ability fifth graders did unaccountably better than other lower ability readers on the cued recall task.

Insert Figure 1 about here

Intercorrelations of the three measures of ability with primary and secondary meanings of each task at each grade level indicated that the three measures of ability were systematically correlated with the responses. In all grades, for both tasks, the secondary sense of the word was correlated more highly with ability than was the primary sense of the word. The correlations are listed in Table 2. It should be noted that a ceiling effect with primary meanings may have reduced those

correlations. Also, the fifth grade teacher assessment variable had lower correlations with other variables than did teacher assessment at the fourth and sixth grades. This discrepancy may have led to the 3-way interaction found in the analysis of variance.

Insert Table 2 about here

Discussion

The results indicate that children perform at a higher rate when the primary sense of the targeted words is referenced than when the secondary sense appears. This effect is influenced by reading ability but not by grade; also, it is more significant in the recognition task than in the cued recall task.

The effect of reading ability on both tasks as well as significant correlations of reading ability with secondary meanings suggest that knowledge or memory of secondary meanings is faulty, even in sixth grade and even though these words had appeared in a secondary sense in textbooks. Because lower ability readers are particularly hampered by this task, it is likely that their comprehension of text is impaired by words which reference less common meanings. Furthermore, the lack of a grade effect implies that instruction in knowledge of multiple meanings either does not occur or is not effective for all students.

Unexpectedly, the error rate on the cued recall task was higher than the error rate on the recognition task. One possible reason is that recognition is biased by the presence of primary meanings--children

see the primary meaning and forget the disambiguating sentence. Another possibility is that they do not know the secondary meanings; they score higher on cued recall because they recall surface information, not because they understand secondary meanings. These tasks do not distinguish between these two interpretations. For this reason, a second experiment was planned in order to determine whether children were simply forgetting the sentences or actually did not know secondary meanings. Here, sentences and multiple choice responses were put together so that children would not be required to remember sentences.

Experiment 2

Method

Materials. Two of the 20 words were replaced and several of the sentences rewritten to obtain sentences that more clearly disambiguated word meanings through the context. Target (polysemous) words were underlined and a 5-choice response followed each sentence. As before, the materials were set up in an A-B, B-A design so that a sentence supporting a primary meaning appearing in Form A could be contrasted with a sentence supporting a secondary meaning in Form B; each form contained ten primary and ten secondary target words. Here is an example (hit is the primary meaning of strike):

(Form A) Pete is going to strike the ball.
(Form B) The union is going to strike tomorrow.
(Form A & B) a) meet together
b) hide
c) stop work
d) hit
e) no answer

Note that each sentence has a correct response, a contextually acceptable response, and an anomalous response. The (e) response was added to reduce guessing, and two unscored items were placed third and fourteenth in the materials to make that an acceptable response.

Subjects. All the third and fourth grade children of a town of 2,000 in central Illinois were tested. They were tested by the first author who elicited the cooperation of every child; no one was unable to do the task. They were given as much time as they needed, with everyone finishing in 20 minutes.

Procedure. The children were told to "read each sentence very carefully, thinking about what the underlined word means in the sentence. See if one of the choices below the sentence means about the same thing as the underlined word and can fit in the sentence. If so, circle it; if not circle no answer." They were also told any words that they could not read but were given no hints about the meaning.

Results

In an analysis of variance, a quasi F ratio was constructed because subjects and word meaning were random effects variables, and form and grade were fixed effects. There was a significant effect of word meaning, $F'(1,40) = 20.5$, $p < .01$, $\bar{X}$(primary meaning) = 72% correct and $\bar{X}$(secondary meaning) = 42%, and a marginal interaction between form and grade, $F'(1,56) = 4.25$, $p < .05$.

Error responses showed that children were more likely to circle responses that supported the context of the sentence when the word was

used in its primary sense but circle the primary meaning of the word when the word appeared in its secondary sense. A Chi square analysis using Yates correction indicated that these changes are highly unlikely to be a random fluctuation (see Table 3).

Insert Table 3 about here

Discussion

The second experiment illustrates that primary meanings of words are selected even when children can refer directly to supporting context. This suggests that children have a limited knowledge of words and are not able to use context in a satisfactory manner to figure out meanings of words. In this second study, children scored 72% on recognition of primary meanings but only 42% with secondary meanings. In the first, under a memory condition, there was an even larger difference, from 89% to 43%.

Error responses on the second study are also revealing. Children made context-dependent response errors when the word was used in its primary sense but made word meaning-dependent response errors when the sentence called for a secondary meaning. A good example of context dependency was the word bay which many central Illinois children apparently did not know even in its primary sense. More of them chose dock, which fit in the sentence, "The foreign ship was in the bay," rather than inlet. They did not select bush, the alternate, meaning-dependent response. Meaning-dependency occurred with the word rent. Children chose pay for instead of

tore or saw in the sentence, "The man rent his net on the rocks," even though pay for fit neither syntactically nor semantically.

Experiment 3

Since reading ability information was not available on children tested in Experiment 2, the materials from the second experiment were used again to determine whether the ability-by-word-meaning interaction obtained in Experiment 1 would replicate. It was not clear whether this interaction had been obtained because low ability readers are less aware than high ability readers of words used in their secondary sense or because the memory condition in the first experiment had compounded the difficulty of the task for low ability readers.

Method

Materials. Experiment 2 materials were given to children with one additional instruction. Children were asked to estimate how sure they were that each answer was correct. They put 3 pluses if they were very sure they were correct, 2 if they were a little bit sure, 1 if they made a good guess and 0 if they were not sure at all. This provided a measure of their ability to rate their accuracy. In the same session, they were also given a grade 4 level cloze passage in which every fifth word was deleted. The number of correctly filled in words served to measure reading ability.

Subjects. Eighty children in grades 3 and 4 were tested. The children were from a middle income residential neighborhood in Halifax,

Nova Scotia. All of the children were tested in their classrooms and served voluntarily as subjects in this study.

Results

As in the second study, a quasi F ratio was constructed in order to consider the word meaning and subjects variables as random effects. Children were divided into three groups on the basis of their cloze score to obtain a reading ability measure, $\overline{X}$(higher) = 14.2, $\overline{X}$(middle) = 9.5, $\overline{X}$(lower) = 4.0. Using accuracy on the word meaning test as the dependent variable, there were significant effects of word meaning, $F'(1,37) = 14.3$, $p < .001$, ability, $F'(2,133) = 24.1$, $p < .001$, and grade, $F'(1,68) = 11.4$, $p < .01$. With children's rating of their answer as a dependent measure, word meaning was significant, $F'(1,37) = 6.6$, $p < .05$, as was ability, $F'(2,133) = 3.3$, $p < .05$. There were no significant interactions. Mean scores for these effects are listed in Table 4.

Insert Table 4 about here

Correlations among the variables of grade, ability (the cloze score was used here rather than the 3-valued variable computed for the ANOVA), accuracy on the word meaning task (this was the sum of the scores on primary and secondary meanings), and rating ability (values could be from 0-3) showed that all the intercorrelations were significant at $p < .01$ (Table 5). A further analysis by grade and by ability showed that third graders were better able than fourth graders to rate their accuracy ($r = .60$ in grade 3; $r = .22$ in grade 4), and low ability readers were

better raters than middle or higher ability readers (r = .61, .26, and .49, respectively). Similarly, the relationship between the cloze score and the rating judgment was also higher in grade 3 (r = .53) than in grade 4 (r = .03). One reason for these differences is that fourth graders and better readers were more overconfident than other children--they usually marked 3 pluses (very sure) even though they had a 30-40% error rate.

Insert Table 5 about here

Discussion

The effect of context in identifying meanings of words has again been replicated. Children are more likely to circle a correct meaning when sentences support a primary than a secondary meaning. However, an by word meaning interaction (obtained only under a memory condition) is not characteristic of a word choice (recognition of meaning) task. Instead, significant ability and grade effects suggest that with reading skill and experience children know more meanings of words and become better able to use context to assign appropriate meanings to words.

The rating judgment which only grades 3 and 4 Nova Scotia children were asked to do indicates that children are not good estimators of their answers. Since the average overall accuracy was a little better than 50%, the average rating should have been closer to 1.50, certainly not as high as 2.35. Looked at in that manner, it is apparent that on this task most of the children, particularly fourth graders and the average and better readers in third grade overestimated their ability to choose a meaning from context. Also, although all the children were somewhat more confident

of words appearing with primary meaning support than of words with secondary meaning support, the difference does not match the very large difference in error rate.

Conclusion

When children are asked to identify or remember word meanings by reading sentences which provide disambiguating clues, they do not effectively identify from context or remember from context the less common or secondary meanings of words. Under an additional memory constraint, lower ability readers are further hampered by the task of selecting a correct secondary meaning. They do not remember the context to choose a secondary meaning.

Third and fourth grade children cannot estimate accurately what they do not know. They can be misled by the apparent familiarity of a word to believe that they have made a correct identification of a meaning. We suspect that they are misled because they are significantly more likely to circle a primary meaning when a sentence supports another meaning but circle a context-supporting error when they do not know the primary meaning. This suggests insufficient attention to the semantic content of sentences as well as an insufficient knowledge of multiple meanings and words.

It is apparent that apart from vocabulary knowledge being not well developed, vocabulary use is neither accurately appraised nor satisfactorily identified from written context. This occurs even when children are warned that they need to attend to the sentence information. Instead they rely on their knowledge of primary meanings. The role of vocabulary in reading comprehension, then, has at least three aspects: knowing a meaning of a

word, knowing more than one meaning, and knowing how to choose the right meaning. Children seem to be proficient on only the first mentioned aspect, single meanings of words.

In two of the three experiments, children in the higher grade did not outperform children in a lower grade. Since this is contrary to what would be expected among schooled children, we scanned the grades 4-6 workbooks from eight popular basal reading series to determine whether children receive instruction about multiple meanings or about how to use context to determine an appropriate meaning. The results were not surprising. All but one of the series had fewer than six pages of activities. In most of these, children had to read sentences or a paragraph and then choose the correct meaning from dictionary-like entries or lists of meanings. The exercises, then, were similar to the materials given here to third and fourth graders. It seems likely, given the kinds of errors we now know children make, that these exercises may assess children's ability to do the task but may not teach them to discriminate common from uncommon meanings.

The low scores and the strong ability effects but weak grade effects obtained here suggest that alternate instructional activities ought to be considered. Here are some possible tasks for children: (1) locate words in sentences that, because of context, must be assigned an uncommon meaning and figure out the meaning; (2) create sentences which require the use of an uncommon meaning of a word; (3) list alternate meanings of words and construct sentences for each meaning; (4) learn alternate word

meanings by studying derivations of meanings from other languages, effects of historical change, or effects of form class change; (5) figure out from context uncommon and unfamiliar meanings of words, or (6) study sentences which contain polysemous words to determine how context serves as a clue to word meaning. These tasks, then, are intended to emphasize the two aspects of vocabulary that are neglected in the elementary school reading programs--extension of vocabulary knowledge to multiple meanings and using context to select appropriate meanings.

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Table 1

Mean Proportion Correct on Each Task as a Function of Grade, Ability, and Word Meaning

	Cued recall	Multiple choice recognition
Grade		
4	.71	.62
5	.77	.66
6	.73	.72
Ability		
Low	.61	.56
Middle	.75	.65
High	.86	.79
Meaning		
Primary sense	.80	.89
Secondary sense	.68	.44

Table 2

Intercorrelations* of Reading Ability, Task and Meaning

for Children in Grades 4, 5, 6

	Teacher assessment	Vocabulary	Comprehension
Grade 4			
Teacher assessment	---		
Vocabulary	.52	---	
Comprehension	.59	.88	---
Cued recall, primary sense	.48	.30	.36
Cued recall, secondary sense	.61	.49	.51
Recognition, primary sense	.13	.22	.23
Recognition, secondary sense	.39	.29	.35
Grade 5			
Teacher assessment	---		
Vocabulary	.23	---	
Comprehension	.42	.88	---
Cued recall, primary sense	.17	.21	.22
Cued recall, secondary sense	.35	.30	.39
Recognition, primary sense	.24	.12	.27
Recognition, secondary sense	.50	.28	.40
Grade 6			
Teacher assessment	---		
Vocabulary	.52	---	
Comprehension	.54	.88	---
Cued recall, primary sense	.34	.23	.19
Cued recall, secondary sense	.49	.35	.38
Recognition, primary sense	.11	.08	.07
Recognition, secondary sense	.46	.41	.45

*$p < .01$ when $r > .39$

Table 3

Chi Square Analysis of Error Responses of 97 Grade 3 and 4 Children as a Function of Sentential Support

Multiple choice error responses	Support for primary meaning		Support for secondary meaning	
	Observed	Predicted	Observed	Predicted
Alternate word meaning foil	32	(70)	233	(195)
Context support foil	86	(48)	98	(136)

$\chi^2 = 66.9$, $p < .001$

Table 4

Mean Proportion Correct and Mean Rating as a Function of Grade, Word Meaning, and Reading Ability

Variable	Proportion correct	Rating score
Grade		
3	.49	2.20
4	.63	2.52
Context support		
Primary meaning	.69	2.44
Secondary meaning	.43	2.27
Ability		
High	.71	2.48
Middle	.57	2.46
Low	.40	2.13

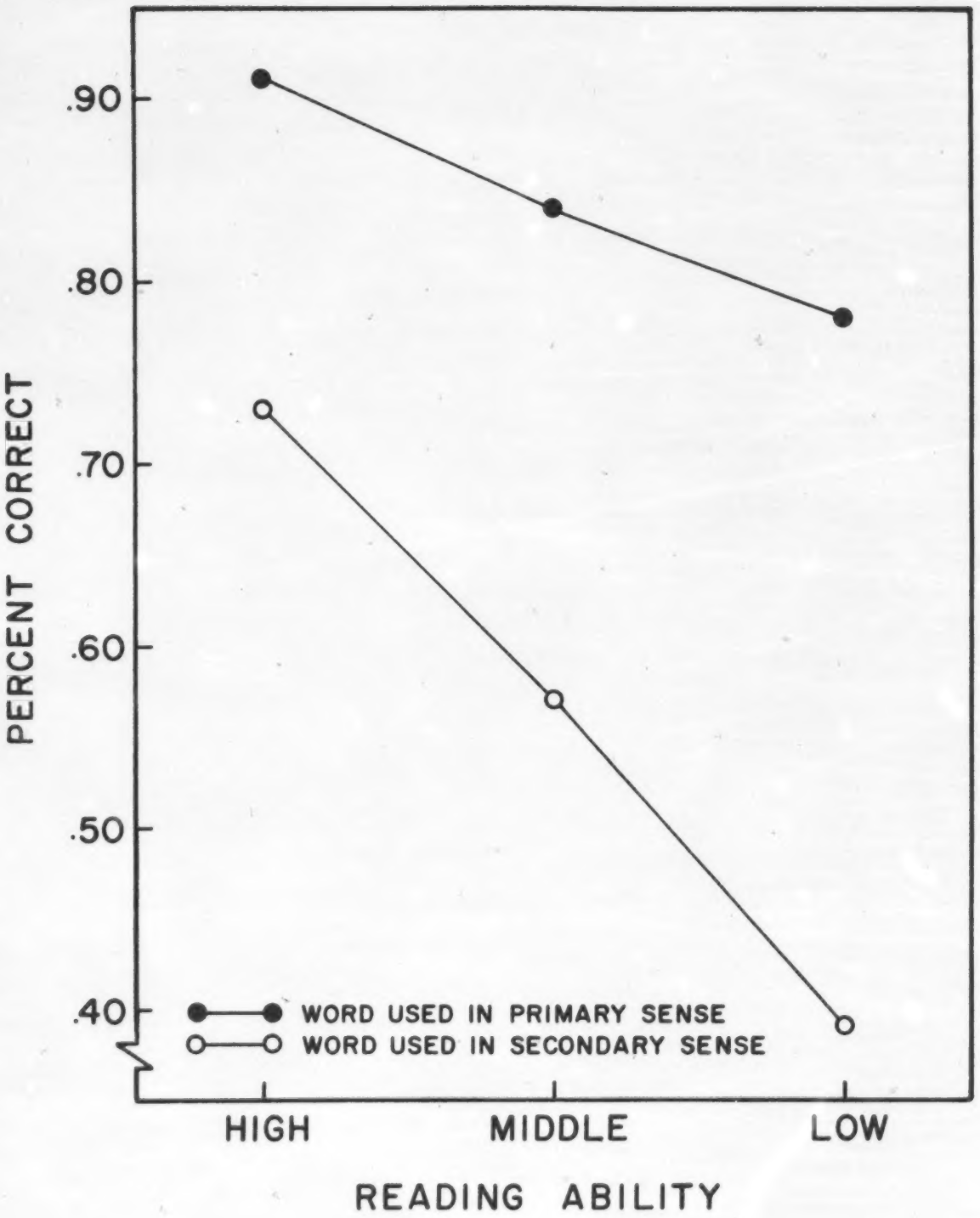
Table 5

Intercorrelations among Cloze Ability, Word Meaning Ability, and Rating of Word Meaning for Children in Grades 3 and 4 (n = 80)

Variables	Grade	Cloze score	Word meaning score	Rating judgment
Grade	---			
Cloze score	.37	---		
Word meaning score	.36	.73	---	
Rating judgment	.28	.39	.50	---

Figure Caption

Figure 1. Interaction between teacher assessment of reading ability and meaning of words in sentences.


.90
.80
.70
.60
.50
.40
PERCENT CORRECT
WORD USED IN PRIMARY SENSE
WORD USED IN SECONDARY SENSE
HIGH
MIDDLE
LOW
READING ABILITY

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